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THE ENVIRONMENTAL IMPACT OF PEAT COMBUSTION IN WOODSTOVES AND PARTICULATE FUEL BURNERS

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EXECUTIVE SUMMARY

Peat combustion tests were conducted using three woodstove designs - a Chaleureux non-baffled, a Lakewood baffled, and a Kent high-tech stove and three particulate fuel burners - a TP2000 50 kW stoker, a Swebo 65 kW pre-heater and the Volcanic Glow pellet stove.

The objectives of the study were to determine the particulate emission levels and efficiencies of the various appliances using peat at several moisture contents. Extruded sods were burned in the stoves while peat pellets were burned in the particulate fuel burners.

The study showed that pellet burning appliances can burn peat with very low emissions, and that drying peat sods before they are burned can bring about substantial decreases in particulate emissions.

Résumé

Des essais de combustion ont été effectués avec de la tourbe dans six appareils - un poêle Chaleureux sans déflecteur, un poêle Lakewood avec déflecteur et un poêle haute technologie Kent ainsi que dans deux brûleurs à combustible particulaire, le TP2000 50 kW, le Swebo 65 kW et un poêle à granule, le Volcanic Glow.

Le but de ces essais étaient de déterminer les niveaux d'émissions particulaires et les rendements de ces différents appareils avec de la tourbe à divers taux d'humidité. Des extrusions de tourbe ont été brûlées dans les poêles à bois et des granules de tourbe dans les brûleurs à combustibles particulaires.

Les essais réalisés avec les brûleurs à combustible particulaire étaient excellents. Les résultats des essais effectués avec les poêles à bois ont indiqué que le séchage de la tourbe avant la combustion amène des baisses considérables d'émissions particulaires.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 OBJECTIVES 2

3.0 METHODOLOGY 3

3.1 The Fuel 3
3.2 Moisture Content 4
3.3 CSA B415 performance testing 6

4.0 DESCRIPTION OF TEST APPLIANCES 10

4.1 Woodstoves 10
4.2 Pellet stove 11
4.3 Particulate fuel burners 11

5.0 B415 TEST RESULTS 15

5.1 Particulate emissions 15
5.2 Efficiency 19

6.0 OBSERVATIONS 21

7.0 CONCLUSIONS 22

8.0 RECOMMENDATIONS 23

APPENDICES

A - Discussion on Sources of Error in Efficiency 24

B - Ultimate Analyses of Fuels 26

C - Manufacturer's Advertising Brochures 29

1.0 INTRODUCTION

Over fifty percent of Newfoundlanders burn wood to satisfy some or all of their space heating needs. Large portions of Newfoundland are covered with peat bogs where few trees grow. Peat replaces wood as an alternative fuel in many homes on the Southern Avalon Peninsula. While there is no objection to using peat as a fuel in Newfoundland, we can no longer neglect the environmental effects of burning solid fuels.

Peat is harvested during the summer months and formed into long cylindrical sods by extrusion machines. The sods are left on the fields to air dry. They are turned over periodically to accelerate drying. The harvested peat is stockpiled and sold to commercial distributors who bag it for resale.

For space heating applications the peat is usually burnt in woodstoves. Recent technology developments have produced stoves that burn wood with increasingly lower emissions. Do these high-tech appliances also burn peat with lower emissions? How does drying the peat affect emissions levels? These were the questions that we have tried to answer in this study.

2.0 OBJECTIVES

The objective of this study was to identify means of reducing the environmental impact of burning peat. To do this we have identified the following sub-objectives:

1. To identify the solid-fuel-burning appliances which minimize particulate emissions from peat fuel.

2. To identify those appliances which burn peat with relatively high efficiency,i.e. they use less fuel for the same heat output.

3. To quantify the effects of fuel moisture content on appliance efficiency and emissions.

4. To quantify the effect of fuel type, e.g. sods vs pellets.

3.0 METHODOLOGY

To measure efficiency and emissions from solid fuel burning appliances, we have used the CSA B-415 standard. This standard, however, must be modified for testing appliances other than woodstoves burning wood. The following sections will describe the fuel and the test methodology used in this study.

3.1 The Fuel

IRTA purchased 100 20-kilogram bags of peat sods produced by Avalon Peat Harvesters of St. Shotts, Newfoundland. Thirty of the 100 bags were then pelletized, for use in the pellet stove and pellet furnace only.

The peat sods measure from 10 to 30 centimetres (4 to 12 inches) long, with an average length of 20 cm (8 inches). Their diameter varies between 5 to 7 cm (2 to 3 inches). While the sods are extruded as cylinders, most of the load we received was made of oval pieces, some twice as wide as thick. Many of the extruded sods were left with whiskers which came from the overburden. Twenty percent of the load consisted of unbound pieces and powder. The moisture content of most peat sods in this 100-bag shipment was 60%[1] wet base or higher.

This 60% average moisture reading means that one side of the sod might have been at 70% while the other was at 50% mcwb. This was typical of this lot. Sods had one relatively dry side and one very wet side. As we dried the sods, the moisture distribution within each sod became more uniform.

At 60%, this load's high moisture content contrasted sharply with our previous shipment of 20 bags from the same area at 25% to 30% mcwb. The previous shipment also had pieces which were much more uniform in shape, with much less powder.

To determine the effect of moisture content on stove performance, we had originally planned to condition the peat sods to 25%, 35% and 45% wb. This range was broadened to encompass the high moisture content of our fuel. We decided that it would be important to test at the same moisture content at which this fuel was sold i.e. at 60%. Additional moisture contents of 40 and 20% were used to determine the extent to which fuel drying influences performance and emissions.

The peat pellets we used had a diameter of 6 mm (1/4-inch), and their average length was 20 mm (3/4-inch). The pelletizing of the peat lowered its moisture content to between 30 and 40%.

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[1]All references to moisture content (mc) in this report relate to moisture content on a wet base (mcwb).

Table 1.

Ultimate Analysis of the St-Shotts Peat, Newfoundland				
		Trivett	CCRL 1	CCRL 2
Oven -dry Base	C	54.52	56.40	54.42
	H	5.72	6.10	5.67
	N	1.35	1.50	1.41
	O	36.74	32.63	32.94
	S	0.25	0.82	0.38
	Ash	1.42	2.55	5.18
	Total %	100.00	100.00	100.00
MC as Received	C	33.56	48.01	38.47
	H	3.52	5.19	4.01
	N	0.83	1.28	1.00
	O	22.61	27.77	23.28
	S	0.16	0.70	0.27
	H2O	38.45	14.88	29.31
	Ash	0.87	2.17	3.66
	Total %	100.00	100.00	100.00
	HHV kJ/kg	19126	22640	20830
	(Btu/lb)	8232	9734	8955

Note: Peat has a higher sulphur content than wood, and a higher ash content. Although the analyses are relatively consistent, there are relatively large variations in critical components such as hydrogen.

Trivett: Determination of the Combustion Characteristics of Newfoundland Peat. G. Michael Trivett, October 1983

CCRL1: Analysis from EMR, CANMET, October, 1988
- analysis sheets in Appendix A

CCRL2: Analysis from EMR, CANMET January, 1989
- analysis sheets in Appendix A

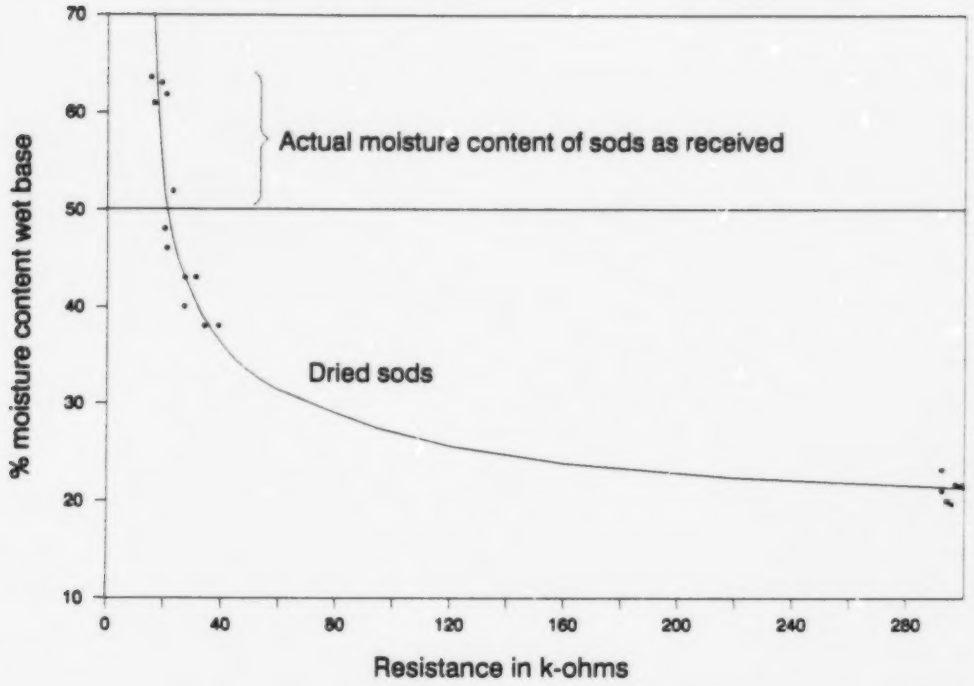
For comparison, CCRL handbooks cite oil as having a sulphur content of 0.2 to 0.3% and coal as 0.5 to 8%.

3.2 Determination of Moisture Content of Fuel

Determining moisture content of the peat sods was a major task. 1600 sods (600 kg of peat) had to be measured individually. To measure moisture content of test sods, we established a correlation between their moisture content as determined by oven drying, and electrical resistance, using a modified wood moisture-meter (Graph 1a). Four readings were taken in each sod. The lowest and highest of the four readings were eliminated and the moisture content was taken as the average of the other two. The sods were sorted into lots according to their resistance and then the mc of sample sods from each lot was determined by oven drying. The resultant mc variation within a lot is illustrated in Graph 1b.

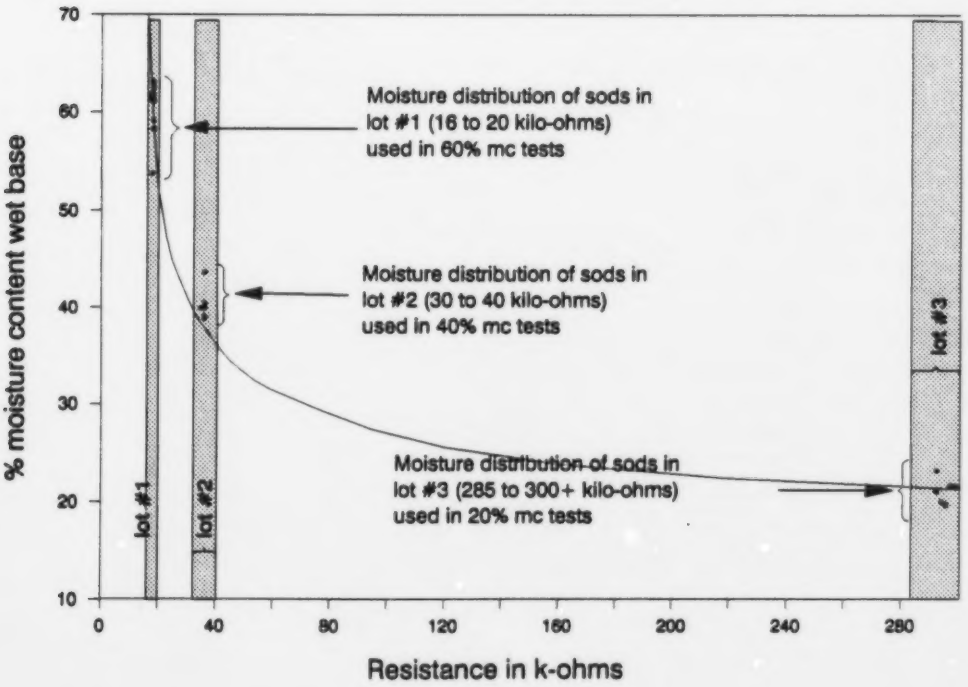
Moisture-Resistance Correlation for Peat Sods

Graph 1a



Actual moisture content of sample sods

Graph 1b



3.3 CSA B415 performance testing (efficiency and emissions)

The CSA B415 standard for efficiency and emissions testing was developed for use with roundwood fuels in stoves. IRTA modified it for use with particulate fuels.

a) B415 testing - efficiency

The CSA B415 standard **"Performance Testing of Solid Fuel Burning Appliances"** describes a test procedure for measuring the overall efficiency and emissions levels of free-standing woodburning appliances at various firing rates. The test involves the calculation of the chemical energy loss (smoke) and heat loss (hot gases) up the chimney. It also measures the total amount of particulates (tars and carbon) produced by incomplete combustion. The procedure involves the burning of a standard wood charge. Flue gas temperature, CO_2, CO, O_2 and the steadily decreasing weight of the fuel charge are monitored. Particulate emissions from each combustion are measured using a dilution tunnel. For details, refer to the CSA B415 standard.

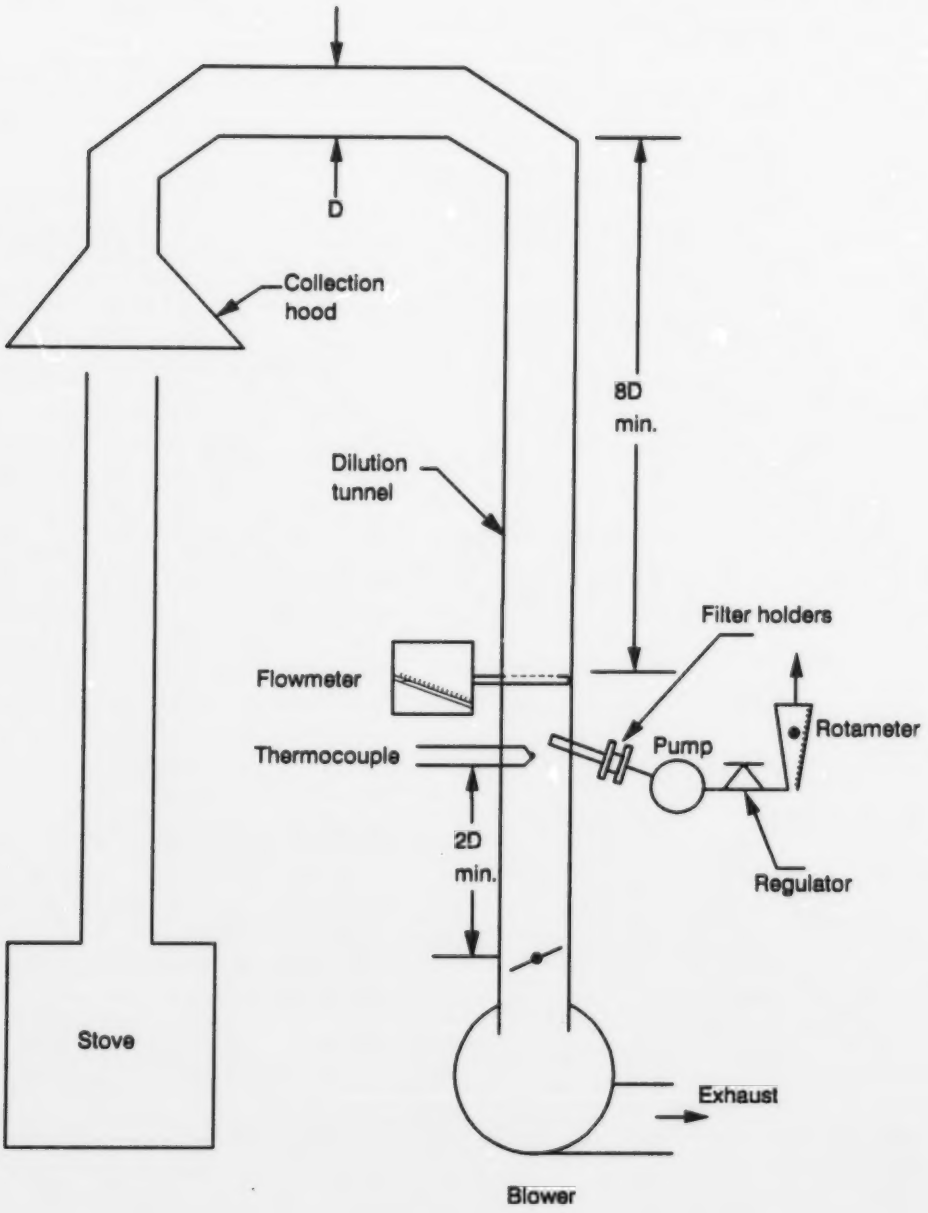
b) B415 testing: dilution tunnel

Dilution tunnel testing is one component of the B415 test standard. It is relatively easy to perform and gives a good indication of how cleanly an appliance burns. It is very suitable for in-plant product development testing. The dilution tunnel test measures only particulate emissions. It does not measure gaseous emissions, efficiency or output. The apparatus necessary for dilution tunnel testing is shown in Figure 1. The total volume of flue gas leaving the appliance is routed through a tunnel where it is mixed with ambient air. Then, a known proportion of the diluted gas flow is pumped through a pre-weighed filter. The filter is re-weighed after the burn. The difference is the weight of the particulate matter trapped by the filter. Since the sample that was passed through the filter was a known proportion of the total volume, the total weight of the particulates emitted can be calculated. The weight can be averaged over time to give a reading in grams per hour (g/h) or it can be divided by the mass of dry wood burned to give a reading in grams of particulate emissions per kilogram of fuel (g/kg) or grams per megajoule (g/MJ) of heat output.

The dilution tunnel method is especially useful in that it provides a means to compare appliance emissions to the compulsory U.S. EPA emission standards.

Figure 1.

Apparatus used in dilution tunnel tests[2]



[2]Taken from the CSA B415 standard "Performance Testing of Solid Fuel Appliances".

c) Modifications to standard test charge for burning peat sods

The B415 test procedure is designed for testing manually-controlled space heaters, at constant combustion air settings burning roundwood. We modified the procedure to burn the peat sods and we used the EPA loading density of 7 pounds per cubic foot[3] for these tests.

A typical test load was made up of approximately 12 to 15 sods. The first layer of sods was placed lengthwise on the coals. The second layer was placed at 90 degrees to the first. The third layer was placed parallel to the first.

Standard B415 tests with wood are done with the fuel at 18% moisture content. We used peat at three moisture contents: 20, 40, and 60%.[4]

d) Modified B415 test procedure for burning peat pellets in a pellet stove and in particulate fuel burners

The CSA B415 test procedure required several modifications in order to test appliances which burn pellets.

- the standard Douglas fir lumber used as test fuel is replaced with peat pellets. The fuel charge no longer depends on the size and geometry of the combustion chamber, and must be redefined in terms of feed rate.

- particulate fuel feed rates are used for the B415 calculations. Feed rates are easily and accurately determined with the pellet stove because the appliance is mounted on a weigh scale and the weight of fuel burnt is recorded throughout the testing.

- the particulate fuel's moisture content is no longer restricted to a range of 16 to 20% wb. The moisture content of the peat pellets was between 30 and 40%.

- test runs are performed over a range of 4 different heat outputs. The pellet stove that was used operates at only one feed rate. The auger stops and starts in response to a thermostat. For testing we replaced the thermostat by a

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[3]7 lb. per cubic foot is the moist density of the fuel i.e. it includes the weight of the water. It will be the new fuel density used in CSA B415. This size of peat charge at 20% mc was found to be the maximum which could be loaded in the woodstoves.

[4]The standard B415 test fuel moisture content is 18% mcwb.

switch to control the stove's operating cycles. Using a 20-minute period, we operated the pellet stove at the following on/off cycles to obtain different output rates.

- continuous operation of auger
- 15 minutes on / 5 minutes off
- 10 minutes on / 10 minutes off
- 5 minutes on / 15 minutes off

- constant fuel composition was used in the B415 calculations as opposed to the variable composition used when dealing with roundwood. When burning roundwood, fuel composition varies with time. More hydrocarbons are burned at the beginning of the cycle whereas at the end the fuel consists mainly of carbon. This is taken into consideration in the B415 calculations for roundwood. A constant fuel composition is used when burning particulate fuels because chemical composition does not vary with time.

4.0 DESCRIPTION OF TEST APPLIANCES[5]

4.1 Woodstoves

The three types of woodstoves chosen for the performance testing were a Chaleureux non-baffled, a Lakewood baffled and a Kent high-tech woodstove. These three types are representative of the woodstove technology which exists today, catalytics excluded.

The non-baffled stove (Fig. 2a) is typical of the original airtight woodstoves. When burning roundwood, these stoves have relatively high emissions. Efforts were then made to improve combustion characteristics of these stoves for roundwood by the addition of a long baffle (Fig. 2b). The high-tech stove is the most efficient and clean burning type for roundwood. It combines the long baffle characteristics with that of proper mixing of secondary air with the outgoing hot gases (Fig. 2c). High tech stoves are often designed with the specific intention of satisfying the U.S. EPA emissions limit for woodstoves.

The three woodstoves selected had the following similarities, in order to eliminate as many variables as possible.

All three woodstoves have approximately the same combustion chamber size.

All three appliances are of steel construction with firebrick lining.

All three woodstoves are equipped with manual controls for combustion air.

All three appliances have 6-inch diameter flues.

a) Chaleureux

The Chaleureux woodstove has a combustion chamber volume of 60 litres (2.1 cu ft). Combustion air enters through inlets in each of its cast iron doors. The combustion air is directed straight at the fire. The combustion gases leave the unbaffled chamber to exit directly to the flue.

b) Lakewood Cottager

The Lakewood's combustion chamber has a volume of 62 litres (2.2 cu ft). Two controls placed near the top of the loading door regulate the supply of combustion air. The air is pre-heated slightly by flowing down a few inches inside the door

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[5]The manufacturer's advertising brochures may be found in Appendix C.

lining before being directed at the fire base through three openings. Combustion gases must flow over a 40 cm (16-inch) baffle placed above the combustion chamber before reaching the flue.

c) Kent

The Kent's combustion chamber has a volume of 48 litres (1.7 cu ft). Combustion air enters through two inlets at the top front of the stove. They are controlled by a single slide. The combustion air entry is strategically located in that the air "washes" the glass door clean as it descends to the fire, when burning wood. A portion of the incoming air also mixes with the outgoing gases for secondary combustion. A baffle plate covers the combustion area to increase combustion temperatures. Exiting gases flow through a series of small holes aligned horizontally along the front of the baffle.

4.2 Pellet stove

The Volcanic Glow is a pellet stove. It has a storage bin at the rear of the unit which holds approximately 40 litres (1.4 cu ft) of pellets. An auger moves pellets from the bin to a cast iron retort in the combustion chamber. Forced combustion air is supplied around the circumference of the retort through a series of 8 mm (5/16 inch) holes. A small pipe supplies secondary air above the retort bowl. The combustion gases leave the chamber through a rectangular opening on each side of the combustion chamber's roof.

A thermostat regulates the auger feed by sensing the temperature of the incoming combustion air. A circulating fan is controlled by a heat sensor located on the stove's wall. To facilitate lighting, the auger may be controlled manually.

4.3 Particulate fuel burners[6]

a) TP2000 50 kW coupled to a furnace heat exchanger

The TP2000 50 kW stoker is built in Finland. It has an open combustor bowl that fits inside the furnace heat exchanger.

The surge bin's basic size is 0.5 cubic metre (18 cu ft) and it can be increased to 2 cubic metres (71 cu ft). The bin is sealed and its cover is gasketed. In the bottom of the bin a 9 mm (3-1/2 inch) auger is used to move particulate fuel.

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[6]For testing, the Scotsman wood furnace was used as a heat exchanger for both particulate fuel burners.

The auger delivers fuel through a 11.5 mm (4-1/2 inch) diameter tube to a rectangular cast iron combustor bowl. A fan supplies combustion air through a series of small holes in the sides and bottom. Combustion takes place on three movable grates. The grates move back and forth to prevent ash buildup.

A thermostat controls the stoker's operation. When there is no heat demand, the stoker switches over to its "hold-fire" mode where both the feed mechanism and the combustion-air fan operate on a periodic basis to keep the fire alive.

b) Swebo 65 kW pre-heater (Fig. 3) coupled to a furnace heat exchanger

The Swebo is a Swedish-built pre-heater-type particulate fuel burner. Its combustion chamber is independent from that of the furnace heat exchanger. The appliance is rated at 65,000 kcal/h which is equivalent to 76 kW (258,000 Btu/h).

The surge bin has a volume of 0.71 cubic metre (25 cu ft). It is rectangular at the top and tapers to a circular shape at the bottom.

A 110-volt electrical system powers a 1/2 hp gearmotor which drives the auger shaft. A 85 mm (3-3/8 inch) diameter auger rotates inside 125 mm (5 inch) square tubing to feed the burner.

The Swebo's electrical control regulates fuel feed rates, combustion fan speed and hold-fire modes. Fuel feed rates are chosen from a 5 to 100% adjustment of the auger motor's operating time over a 50-second operating cycle. Combustion air is regulated by a variable speed fan. This air is introduced as a combination of underfire and overfire air. The hold-fire mode can be adjusted from 0 to 10% of the motor's operating time.

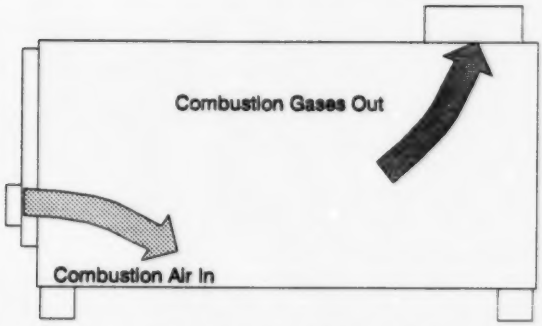
The cylindrical combustion chamber is lined with a thick layer of refractory material. Inside the combustion chamber a paddle, connected to an outside switch, stops fuel feed should the combustion chamber overfill with fuel.

Figure 2.

Different woodstove designs

2a

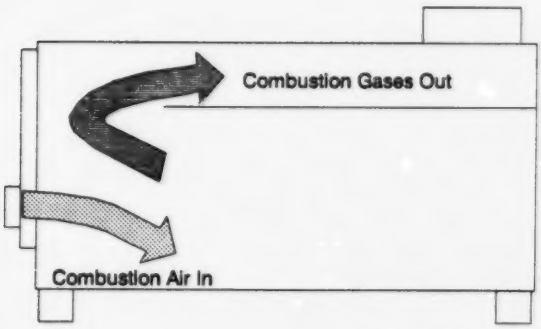
Chaleureux



Non-baffled Woodstove

2b

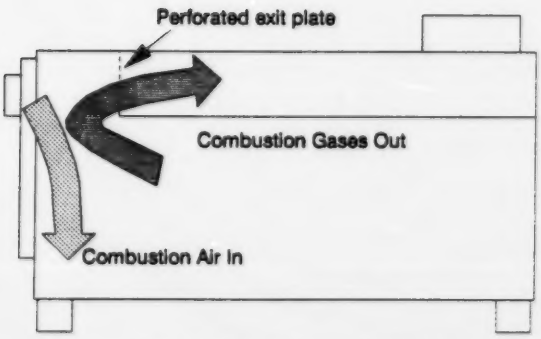
Cottager



Baffled Woodstove

2c

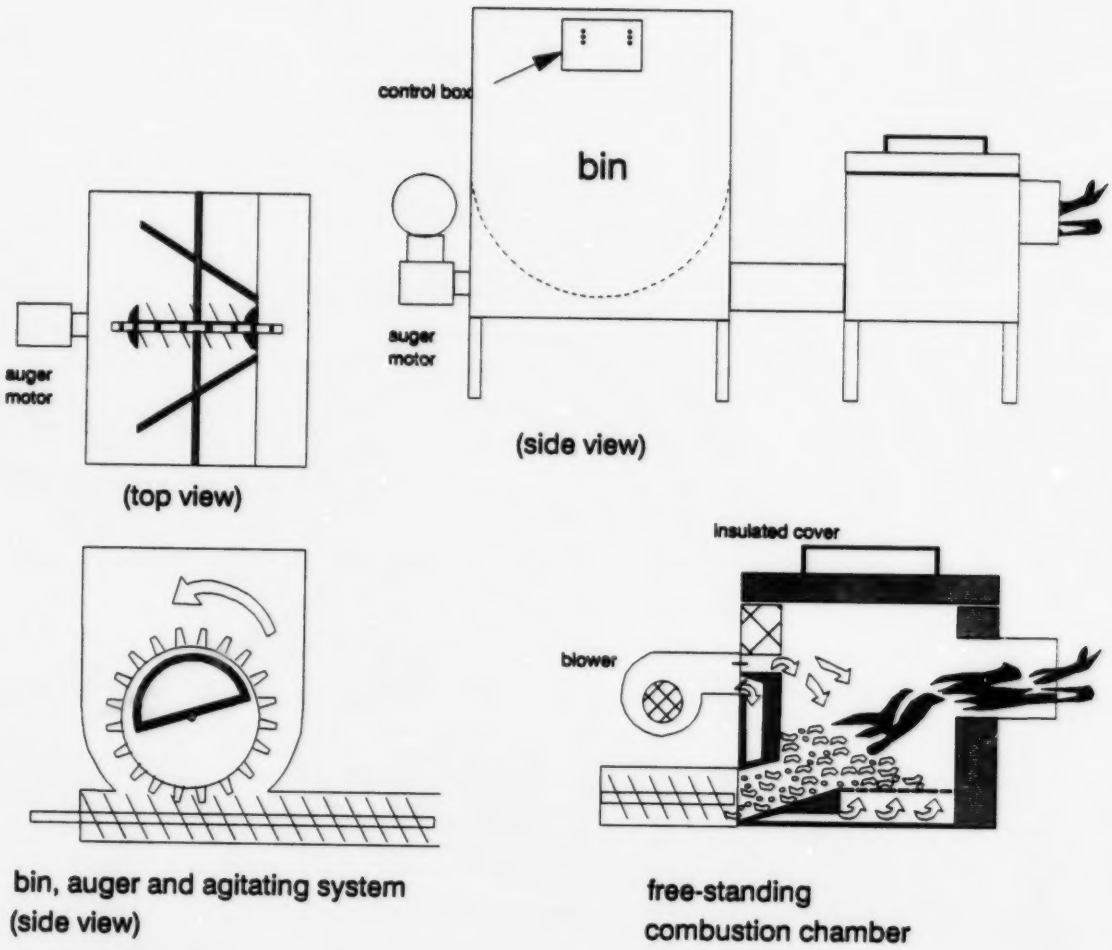
Kent



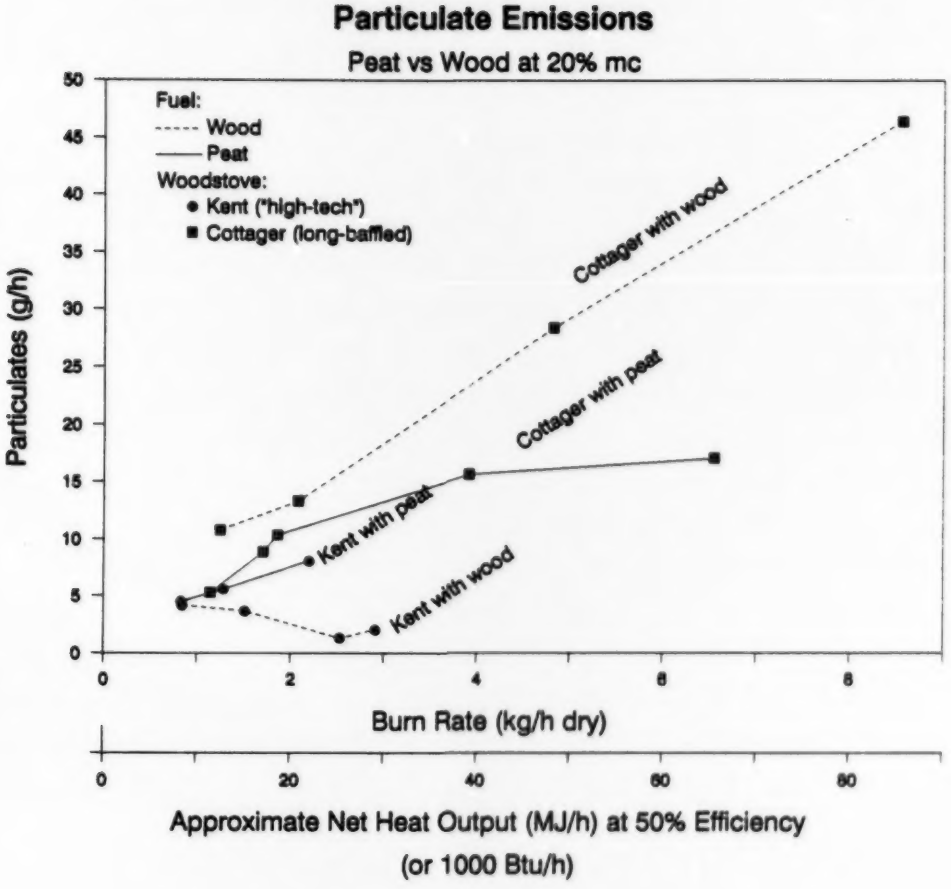
"High-tech" Woodstove

Figure 3.

Swebo pre-heater



Graph 2



5.0 B415 TEST RESULTS

5.1 Particulate emissions

a) Particulate emissions of woodstoves: wood[7] vs peat sods, at 20% m.c. (Graph 2)

- the "high-tech" woodstove (Kent) burns <u>wood</u> with much lower emissions than the long-baffled woodstove, at similar burn rates.

- however, when burning <u>peat</u>, the "high-tech" stove burns with approximately the same emissions level as the baffled stove.

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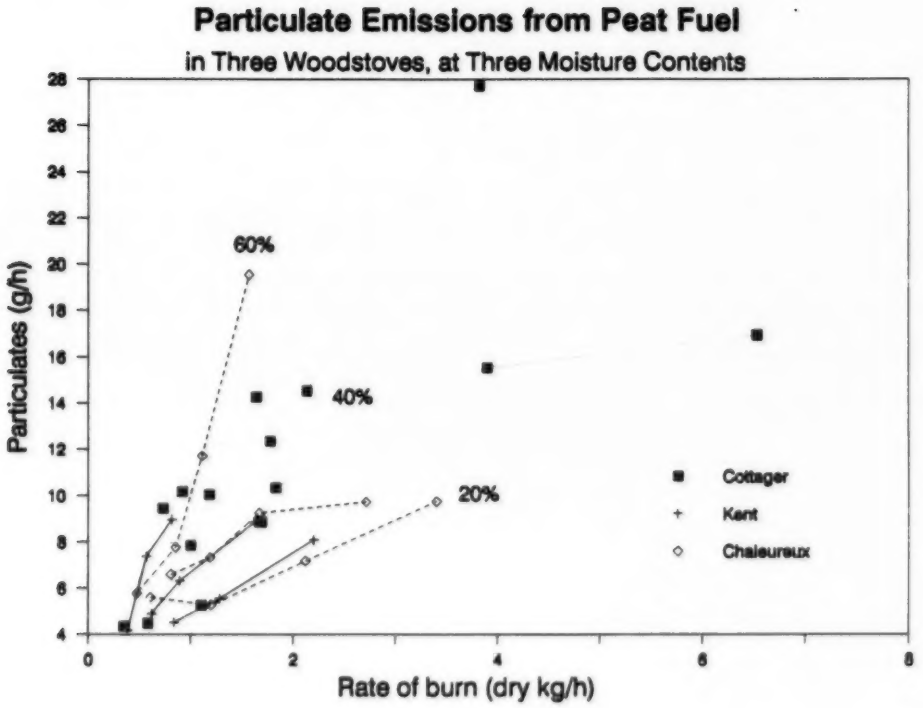
[7]Data on wood combustion stems from previous tests done by IRTA, using an 18% mc Douglas fir charge as specified in CSA B415.

Graph 3



b) Particulate emissions of woodstoves burning peat sods at different moisture contents. (see next page for detailed Graph)

- with all woodstove types, emission levels (in g/h) increase with moisture content.

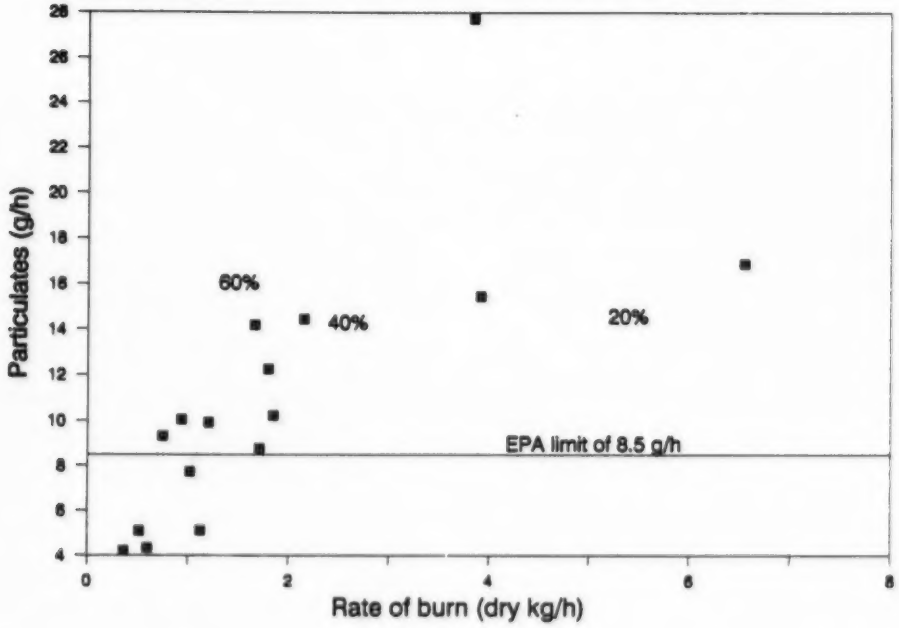
- with all woodstoves types, emission levels (in g/h) increase with burn rate.

- only the "high-tech" stove maintains low emission levels for all moisture contents, over its operating range. Its maximum output is 25 MJ/h (24,000 Btu/h) which is considerably lower than those of both the baffled and non-baffled stoves.

Particulate Emissions from Peat Fuel

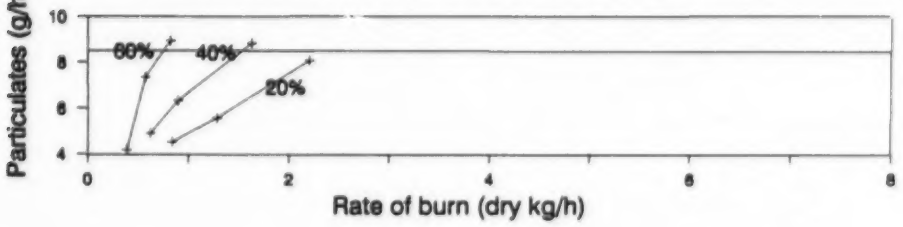
Graph 3a

COTTAGER Woodstove at Three Moisture Contents



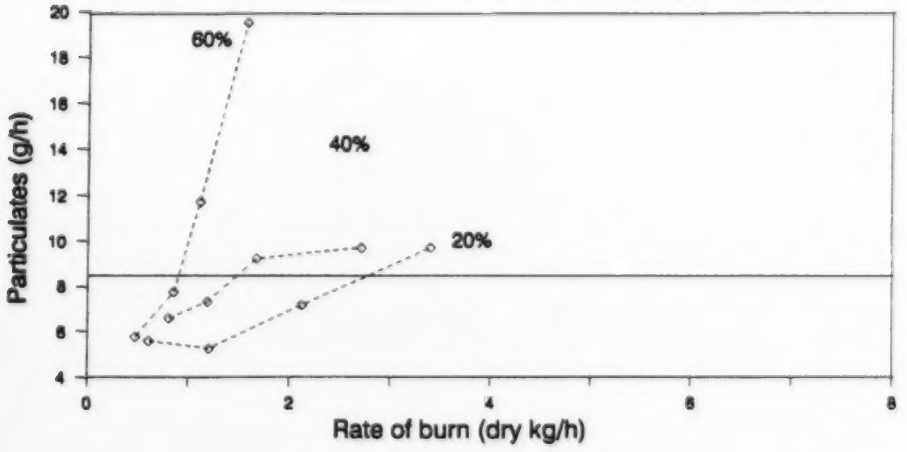
Graph 3b

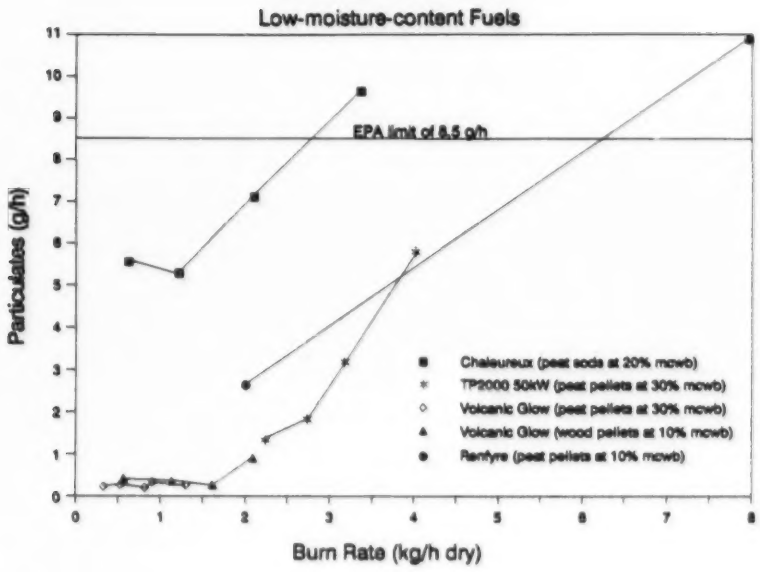
KENT Woodstove, at Three Moisture Contents



Graph 3c

CHALEUREUX Woodstove, at Three Moisture Contents




Particulate Emissions
Low-moisture-content Fuels
EPA limit of 8.5 g/h
Particulates (g/h)
Burn Rate (kg/h dry)
Chaleureux (peat sods at 20% mcwb)
TP2000 50kW (peat pellets at 30% mcwb)
Volcanic Glow (peat pellets at 30% mcwb)
Volcanic Glow (wood pellets at 10% mcwb)
Renfyre (peat pellets at 10% mcwb)

Graph 4

c) Emissions levels of particulate fuel burners burning peat:

- the Volcanic Glow pellet stove burns both peat pellets and wood pellets with very low particulate emission levels. Its heat output would be appropriate for a house with a heat load peaking at 30 MJ/h[8] (29,000 Btu/h).

- the TP2000 50 kW burns peat pellets with low particulate emissions when compared to sods burned in a woodstove. Output from both appliances peak at approximately 50 MJ/h (48,000 Btu/h).[9]

- the Renfyre pellet furnace burns peat pellets with emissions lower than the EPA limit up to 100 MJ/h (95,000 Btu/h).

- in other tests[10], the Laka YHT 29 boiler burning peat at 12% mcwb gave emissions of 40 g/h when operated at peak output of 250 MJ/h (237,000 Btu/h), less than one-third the emissions from burning dry wood in this appliance.

- the Swebo has a difficult time burning peat pellets because of the continuous accumulation of ash on top of the fuel.

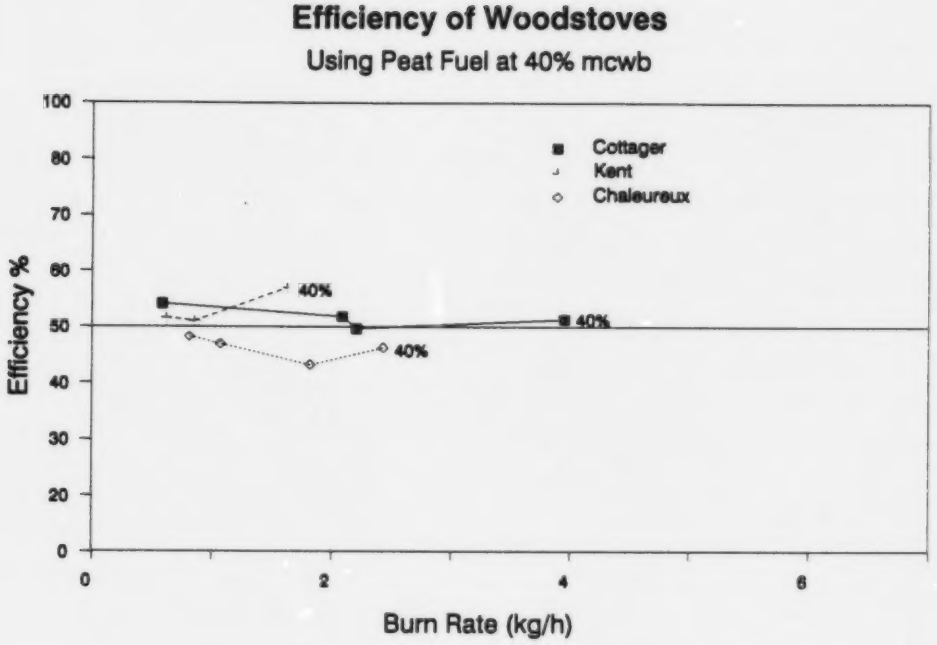
---

[8]1 MJ/h is roughly equivalent to 1000 Btu/h.

[9]Note: Unlike the woodstoves, the Volcanic Glow and the TP2000 will not operate during a power outage because their combustion is totally dependant on their electrical systems.

[10]New Brunswick Research and Productivity Council, January 89.

Graph 5



5.2 Efficiency

The efficiency of a woodstove or particulate fuel burner is the percentage of the energy potential of the fuel input which is extracted by the appliance and delivered as useful heat. The CSA B415 test procedure measures the chemical constituents and temperatures of the gases that are discharged into the chimney flue, converts this data into the equivalent amount of heat, and subtracts this quantity from the energy potential of the fuel input, to estimate the useful heat output of the system.

The woodstove efficiencies for each moisture content are given in Graph 5. Although sources of error exist in these calculations (see Appendix A), trends in efficiencies are quite clear. The Graphs 5a, b and c allow us to make the following observations:

- the efficiency of woodstoves burning peat is reduced as moisture content increases. The typical 12 percentage point loss in efficiency between 20 and 60% mc fuels represents a 20 to 25% loss in fuel; the typical 6 percentage point loss between 20% and 40% mc fuel represents a 10 to 12% loss in fuel.

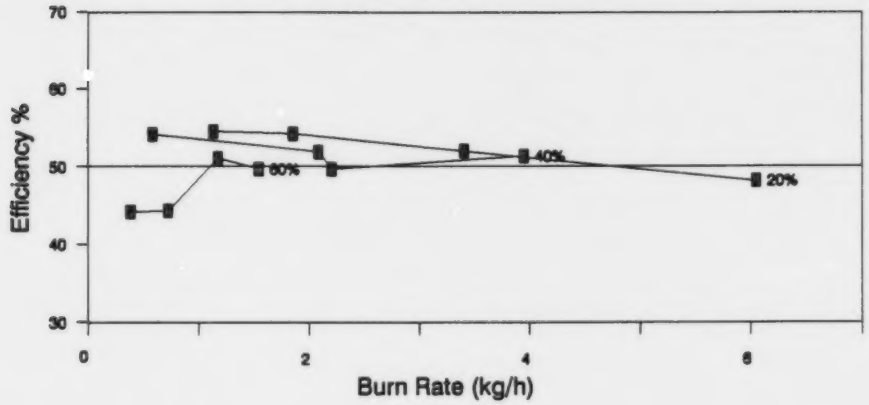
- both the high-tech and the long baffled woodstoves had efficiency levels above 55% when burning peat sods at 20% mc.

- the non-baffled woodstove had a maximum efficiency of 50%. Efficiency when burning peat at 60% mc was as low as 38%.

Efficiency of Cottager Woodstove

Using Peat Fuel at Three Moisture Levels

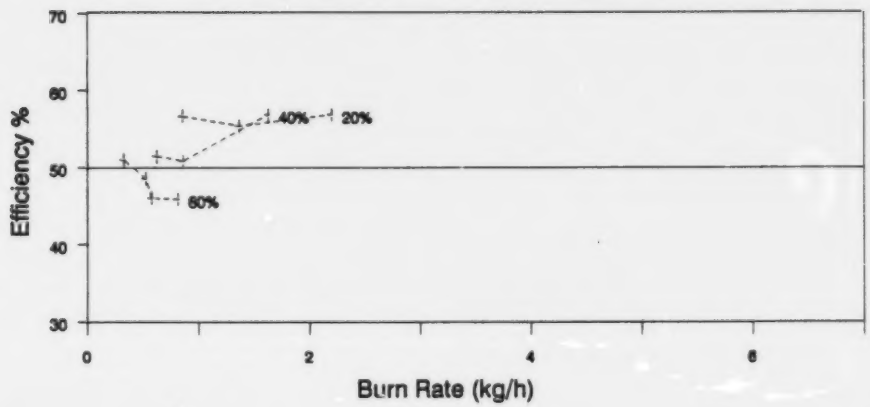
Graph 5a



Efficiency of Kent Woodstove

Using Peat Fuel at Three Moisture Levels

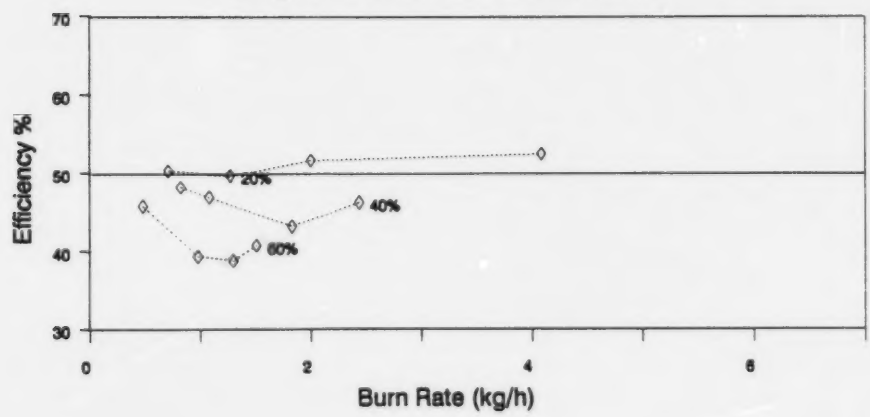
Graph 5b



Efficiency of Chaleureux Woodstove

Using Peat Fuel at Three Moisture Levels

Graph 5c



6.0 OBSERVATIONS

The following observations were made during the study.

1. The peat sods were slightly more difficult to ignite than wood, especially from a cold start.

2. The peat sods produced little flame when burning.

3. The peat sods burned differently than wood. As the pieces burned, they broke and crumbled. This gave a more uniform burn than wood.

4. Burning peat produces a considerably larger quantity of ash than wood (see ultimate analysis). The stoves required more frequent cleaning.

5. Burning peat resulted in a very distinct smell of sulphur. The smoke was black when burning sods in stoves. This was not the case when burning peat pellets in pellet burners. Creosote condensing from peat combustion had a high wax content.

6. Appliance surface temperatures were always well within acceptable limits.

7.0 CONCLUSIONS

1. Drying peat sods to 20% mcwb can reduce fuel consumption by 20 to 25%.

2. Drying peat sods can bring about a substantial decrease in particulate emissions.

3. Peat sods burn with higher efficiency in baffled and high-tech woodstoves than in "old" stoves.

4. Pellet burning appliances can burn peat with very low emissions.

5. Pellet burning appliances can be designed to burn peat with efficiencies of 75%. These efficiencies are 50% higher than those obtained when burning peat sods in woodstoves and thus reduce fuel consumption by one-third.

6. Although some particulate fuel burners can burn pelletized peat, pellet stoves and furnaces perform this specialized function much better.

7. Appliance emissions regulations should relate to heat output, not time, because the use of g/h forces the use of several small appliances whereas use of a single, larger appliance could well reduce the total emissions coming from a building.

8. The use of sod peat to heat homes in Newfoundland could result in 3 tonnes of particulates per year per 100 houses. The corresponding figure for peat pellets would be 90 kg; for oil, 3 kg; for a roundwood furnace, from 6 to 15 tonnes; and for a TP2000 30 kW woodchip stoker, 600 kg.

8.0 RECOMMENDATIONS

1. A study should be done on the economic and environmental impact of a small peat pellet industry.

2. In order to reduce air pollution and to reduce fuel use, peat sods should be dried to 20% moisture content before they are burned in woodstoves.

3. New high-tech woodstoves that satisfy EPA emissions requirements and are capable of burn rates higher than 2.5 kg/h (5.5 lb/h), should eventually be tested for burning peat.

4. Further research should be done to evaluate the peat combustion potential of other stove configurations such as coal stoves with grates, and high tech stoves that are cleaner than the Kent stove when burning wood.

Appendix A

Discussion on Sources of Error in Efficiency

Appendix A

Discussion on sources of error in efficiency

We are wary when using the B415 calculations for measuring efficiencies (as given in Graphs 5) because we are not confident that we can measure parameters to the accuracy required by the calculations. For example, the chemical composition of the fuel is entered into the B415 calculations with its most sensitive factor being the hydrogen content of the fuel. An increase of 0.5 percentage points in hydrogen content produces a downwards shift from 4.8 to 7.5 percentage points in efficiency. This is due to an increase in the computed methane.[11] Table 1, "Ultimate Analysis of the St-Shotts Peat", shows us that it is difficult to predict the hydrogen content of peat to within 0.5 percentage points.

Another source of error is introduced into the B415 calculations by our methodology for determining moisture content (Graph 1a). While our confidence level in the moisture determination of the peat sods is high (Graph 1b) we have still a 5 to 10% error in the determination of the moisture content which is used in the calculations.

A further error is introduced because each peat sod has a wet side and a dry side. This originates from the way it is dried: the effect will be more pronounced on sods that have only been turned once. This has direct effect on the way the peat charge is placed on the coals. Some charges will have more dry fuel on the coals while others will have more wet fuel on the coals. The latter will have a slower start probably resulting in a slower burn with more smouldering.

Work is currently under way to develop an improved procedure for measuring efficiency. The work is being done by Shelton and Jaasma, and is known as the complete carbonization method.

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[11]Ref. Sensitivity Study of Traditional Flue Loss Methods for Determining Efficiencies of Solid Fuel Heaters. Shelton, Graeser and Jaasma; Shelton Research, Inc. Publication, 1984.

Appendix B

Ultimate Analyses of Fuels

[illegible] ... RESOURCES CANADA

[illegible] ... LABORATORIES

[illegible] ... COAL LABORATORY/EGA GENERAL REPORT

LAB SAMPLE ID : [illegible]

CLIENT SAMPLE ID : [illegible]

PROJECT CODE : [illegible]

SUBMITTED on 10-OCT-89

REPORTED by J.

INDEXED on 11-OCT-89

SUBMITTED by [illegible]

SEAM SAMPLE

	AS ANALYZED	DRY @ 105°C	DRY ASH FREE
PROXIMATE ANALYSIS (WT %)			
AS ANALYSED- MOIST	14.90		
ASH	[illegible]	[illegible]	
VOLATILE	[illegible]	[illegible]	[illegible]
FIXED C (BY)	[illegible]	[illegible]	[illegible]
ULTIMATE ANALYSIS (WT %)			
CARBON	[illegible]	56.40	[illegible]
HYDROGEN	[illegible]	[illegible]	[illegible]
NITROGEN	1.26	1.50	[illegible]
SULPHUR : TOTAL	[illegible]	[illegible]	[illegible]
OXYGEN BY DIFFERENCE	27.77	32.83	[illegible]
CALORIFIC ANALYSIS			
CAL / G	4603.	5408.	5340.
MJ / KG	19.27	22.64	23.29
BTU / LB	8285.	9734.	[illegible]

[illegible] V. Whelan

SECTION HEAD

DEPARTMENT OF ENERGY,MINES AND RESOURCES CANADA 19-JAN-89
CANMET/ENERGY RESEARCH LABORATORIES PAGE 1
FUELS CHARACTERIZATION RESEARCH LABORATORY/EQA GENERAL REPORT

LAB_SAMPLE_ID : SE890042 CLIENT_SAMPLE_ID : SAMPLE 1
PROJECT CODE : 8400CR
SUBMITTED on 9-JAN-89 REPORTED by J.G.
INDEXED on 9-JAN-89
SUBMITTED by I.R.T.A. C.P.250, CLARENCE CREEK ONTARIO,CANADA,KOA 1NO.

SAMPLE OF PEAT

	AS ANALYZED	DRY @ 105°C	DRY ASH FREE
PROXIMATE ANALYSIS (WT %)			
AS ANALYSED- MOIST	29.31		
ASH	3.66	5.18	
VOLATILE	47.33	66.95	70.61
FIXED CARBON	19.70	27.87	29.39
ULTIMATE ANALYSIS (WT %)			
CARBON	38.47	54.42	57.39
HYDROGEN	4.01	5.67	5.98
NITROGEN	1.00	1.41	1.49
SULPHUR : TOTAL	0.27	0.38	0.40
OXYGEN BY DIFFERENCE	23.28	32.94	34.74
CALORIFIC ANALYSIS			
CAL / G	3517.	4975.	5247.
MJ / KG	14.72	20.83	21.97
BTU / LB	6331.	8955.	9444.

SIGNATURE D Clug

SECTION HEAD

Appendix C

Manufacturer's Advertising Brochures

Chaleureux

Chaleureux
Distributeur autorisé:

Authorized Dealer:

CORBRON FOUNDRIES LTD.
BOUNDARY RD., BOX 1119 CORNWALL, ONTARIO K6H 5V2 (613) 938-9221

Chaleureux

"vous invite à comparer"

Qu'attendez-vous d'un poêle à bois?

Nous croyons que vous recherchez deux choses:

- un poêle de belle apparence qui ajouterait beauté et valeur à votre demeure
- mais le plus important est un moyen de réduire le coût de votre chauffage.

Comment choisir un poêle à bois?

Il est évident que tous les poêles sont différents; donc avant d'acheter, considérez les faits suivants:

- La capacité de chaleur du poêle convient-elle à vos besoins?
- Le poêle s'opère-t-il facilement et contient-il une bonne quantité de bois?
- Est-ce-que les conduits d'air sont précis?
- Le poêle est-il durable? Un acier trop mince peut onduler.
- Le poêle est-il hermétique? Vérifiez s'il y a des fissures et défauts.
- Les portes se ferment-elles hermétiquement?
- Les instructions du manufacturier sont-elles fournies?
- Y a-t-il une garantie écrite?

Notre politique chez Corbron, étant d'améliorer constamment nos produits, les spécifications ainsi que toute autre information pertinente sont sujettes à changement sans avis.

"invites you to compare"

What Do You Want In A Wood Stove?

We believe most consumers are basically after two things:

- a good looking stove to add beauty and value to their home
- most important a means of reducing their heating costs.

How Do You Choose A Wood Stove?

No one stove is best for all situations. Before you buy, consider the following:

- Does the stove's heating capacity suit your needs?
- Does the stove operate easily and handle a good supply of wood?
- Are draft controls precise?
- Is the stove durable? Thin steel will warp.
- Is the stove air-tight? Inspect for leaks and cracks.
- Do doors shut tightly?
- Are there manufacturer instructions?
- Is there a written warranty?

Corbron's policy is one of continual product development. In order that we may make improvements at any time, specifications and other information are subject to change without prior notice.

Regardez de plus près! **Chaleureux** *vous tentera!*

Chaleureux

Have a closer look!

There is more to **Chaleureux** *than meets the eye!*

DOOR CLOSURE
Our fully gasketed triple lock seal insures perfect closure every time.

FERMETURE
Nos portes scellées, 3 rapports, assurent une fermeture parfaite en tout temps.

HANDLE
Heavy weight, coil handle insures proper closure yet cool to the touch.

POIGNÉES
Les poignées durables, de style spirale, assurent une opération parfaite de la porte et ne sont jamais chaudes à manipuler.

DOOR
Sculptured door design is picturesque. Doors are made of quality cast iron (26 lbs. - 11.8 kg.) and individually fitted to ensure perfect closure.

PORTE
La sculpture de ces portes est pittoresque pour ajouter à la beauté et au charme du poêle. Ces portes, pesant 26 lbs. - 11.8 kg. chacune, sont fabriquées de fonte de qualité et sont ajustées individuellement pour assurer une fermeture parfaite.

COOKING SURFACES
Three cooking surfaces with different temperatures.

SURFACE POUR CUISSON
Il y a trois surfaces pour cuisson avec différente température à chaque niveau.

WARRANTY
Written warranty.

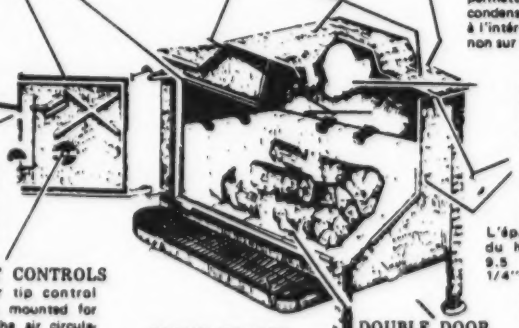
GARANTIE
Il y a une garantie écrite.

BAFFLE
Fully baffled.

DÉFLECTEUR
Déflecteur complet.

FLUE CONNECTOR
Available on top of or back of stove. Smoke pipe fits inside so condensed residue flows back into stove, not on it.

L'ESQUIVATION DE L'AIR
Le tuyau peut être placé sur le dessus ou à l'arrière. Ce tuyau est installé en dedans pour permettre aux résidus condensés de retourner à l'intérieur du poêle et non sur le poêle.



STEEL CONSTRUCTION
Structural steel is boiler plated "the best available". Top is 3/8" - 9.5 mm. thick, sides 1/4" - 6.4 mm. thick.

CONSTRUCTION DU POÊLE
Le Chaleureux est construit d'acier de la meilleure qualité. L'épaisseur de l'acier du haut est de 3/8" - 9.5 mm. les côtés de 1/4" - 6.4 mm.

DRAFT CONTROLS
a finger tip control screw is mounted for setting the air circulation, to regulate the rate at which the fire burns.

CONTRÔLE D'AIR
Vous pouvez régler la vitesse de calibration du contrôle d'air du bout des doigts grâce à l'écrou.

FRONT HEARTH
Extends 6" - 15.2 cm. from firebox for safety.

PALIER AVANT
D'une largeur de 6" - 15.2 cm. pour votre protection.

DOUBLE DOOR OPENING
Two door system provides wide opening for easy, safe loading. Takes up to: 18" – 46 cm. logs and allows excellent visibility. Screens available.

LE SYSTÈME "DOUBLE-PORTES"
Les portes doubles facilitent le remplissage des bûches (jusqu'à 18" – 46 cm.), un pare-étincelles est disponible.

FIREBRICK LINING
Bricks are cut and fitted individually on 5 sides for heat retention. Also these quality bricks protect the stove's life.

BRIQUE RÉFRACTAIRE
Les briques sont coupées et posées individuellement sur les cinq surfaces. Ces briques réfractaires absorbent et retiennent la chaleur pendant qu'elles protègent la vie du poêle.

SYSTÈME DE VENTILATION & PARE-ÉTINCELLES DISPONIBLES.
BLOWER SYSTEMS & SCREENS AVAILABLE.

"THE" STOVE

The Chaleureux stove is unique. The combination of air and inflammable gases contained in the wood gives us radiant and controllable heat. The secondary combustion chamber supplies maximum heat. The wood keeps burning longer. That's the difference between our Chaleureux and conventional wood stoves. Conventional wood stoves do not keep their heat: it escapes up the chimney. The Chaleureux cuts down your heating bill.

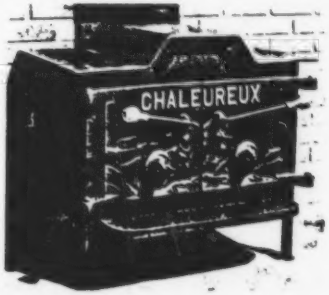
"LE" POÊLE

Le Chaleureux est un modèle unique. Le mélange d'air et les gaz combustibles contenus dans le bois vous donneront une chaleur radiante et contrôlable. La chambre secondaire de combustion vous assure une chaleur maximum. Le bois retient sa chaleur et brûle plus longtemps. Ceci fait la différence entre notre poêle Chaleureux et les poêles à bois. Les poêles à bois conventionnels ne retiennent pas leur chaleur, ils la rejettent par la cheminée. Les poêles Chaleureux vous feront réaliser une économie de frais de chauffage.

Le mot Chaleureux exprime tout. – Chaleureux says it all.

	SERIES 1000	SERIES 500	SERIES 250	SERIES M-100	CHAUDIÈRE/BOILER
POIDS/WEIGHT	500 lbs (225 kg)	450 lbs (250 kg)	375 lbs (170 kg)	250 lbs (113.6 kg)	800 lbs (363.6 kg)
LARGEUR/WIDTH	33½" (76.2cm)	31½" (80cm)	25" (63.5cm)	27" (68.5cm)	19" (48.4cm)
HAUTEUR/OVERALL HEIGHT	30" (67.5cm)	28" (70.1cm)	28" (70.1cm)	30" (76cm)	47½" (121.1cm)
PROFONDEUR/DEPTH	28" (65cm)	22" (57cm)	20" (50.8cm)	18" (46cm)	21½" (54.7cm)
DIAM. DU TUYAU/DIAM. OF FLUE	8" I.D. (20.3cm)	7" I.D. (17.8cm)	6" I.D. (15.2cm)	6" I.D. (15.2cm)	8" I.D. (20.3cm)
OUVERTURE DES PORTES/ DOOR OPENING	22" l/w x 10" h (57cm x 25.4cm)	22" l/w x 10" h (57cm x 25.4cm)	15" l/W x 10" h (38.10cm x 25.4cm)	15" l/w x 10" h (38.10cm x 25.4cm)	Clean out – 16" l/w x 6" h (40.6cm x 15.2cm)
FOYER/FIREBOX	27" l/w x 20" h (63.4cm x 50.8cm)	25" l/w x 14" d (63.8cm x 32.5cm)	19" l/w x 11" d (48.3cm x 27.9cm)	15½" l/w x 11" d (38.4cm x 28cm)	16" l/w 9⅛h (40.6cm x 23.2cm)
CAPACITÉ DE CHAUFFAGE/ HEATING CAPACITY	2500 pi. ca. / sq. ft. (257.5m²)	2100 pi. ca / sq. ft. (195m²)	1500 pi. ca. / sq. ft. (138m²)	1500 pi. ca. / sq. ft. (138m²)	15⅛" l/w x 10½" h (38.8cm x 26.1cm) Water Cap. Eau 24 imp. gal. (88.3 litres)

SERIES 1000

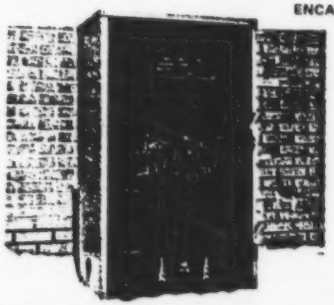


SERIES 500

SERIES 250

SERIES M-100

SERIES 1500
ENCASTRÉ / INSERT



CHAUDIÈRE
BOILER

SPECIFICATIONS

SERIES 1500 ENCASTRÉ/INSERT

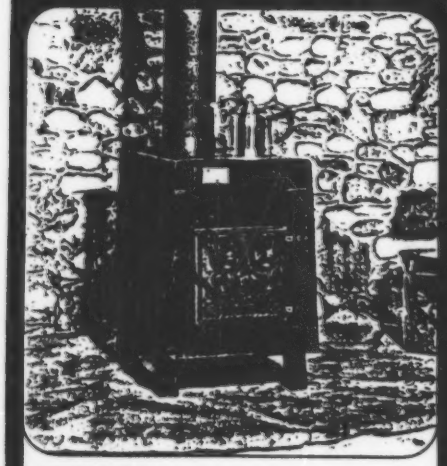
DIMENSIONS HORS TOUT
OVERALL DIMENSIONS

HAUTEUR/HEIGHT	23" (58cm)
LARGEUR/WIDTH	30½" (77cm)
PROFONDEUR INCLUANT LE CENDRIER/ DEPTH INCLUDING ASH TENDER	31" (79cm)

DIMENSIONS DU FOYER
FIREBOX DIMENSIONS

HAUTEUR/HEIGHT	18" (46cm)
LARGEUR/WIDTH	23" (58cm)
PROFONDEUR/DEPTH	22" (56cm)
OUVERTURE DES PORTES/DOOR OPENINGS	21" x 10" (53cm x 25cm)

DIA. DU TUYAU/DIA. OF FLUE	8" ID OVAL (20cm)
GRANDEUR DU SOLIN/FLASHING SIZES	
A	29½" x 42" (75cm x 107cm)
B	32" x 42" or 44" (81cm x 107cm or 112cm)



COTTAGER

Constructed for your safety and efficient heating of home or cottage. Scientifically designed blower and heat exchanger provides maximum heat with a minimum amount of wood. Design tested at over 74% efficiency. The Cottager combines attractive design with efficiency. The blower is optional.

- Top burning efficiency with full Scandanavian baffle.
- Even heat with heat exchanger and optional blower.
- Fully gasketted cast iron door for safety.
- Baffled door for increased efficiency.

Weight	290 lb.
Width	17"
Height	25"
Length	28⅛"
Height to top of flue	26¾"
Diameter of flue	6"
Door opening	9½" x 9½"
Firebox size	13½" W x 21½" D x 15" H
Floor to bottom	5"
Refractory lining	1¼" thick
Blower (optional)	76 CFM

(CERTIFIED BY CSA)

Lakewood Stoves

SPACE AGE TECHNOLOGY

Lakewood's new stoves contain catalytic converters which reduce smoke emissions and creosote build-up and at the same time significantly increase overall efficiency.

Lakewood has been testing new developments for years at the calorimetric room at Ryerson Polytechnical Institute, Toronto, Ontario. Thanks to Lakewood's initiative, great strides have been taken in solving the traditional problems of airtight stoves.

The catalytic converter intercepts the smoke of the airtight stove and burns it before it goes up the chimney. The device is a ceramic honeycomb of varied proportions depending on the stove model. It is coated with a catalyst made of high temperature ceramics and coated with noble metals. When smoke hits the catalyst, a chemical reaction occurs converting carbon monoxide and hydrocarbons to carbon dioxide and water vapour. The reaction generates more heat with less wood minimizing polluting emissions and creosote build-up.

You can count on Lakewood to be the technical leader in stove design and safety with catalytic woodburning results in the specific area of:

- 85% Combustion Efficiency
- 75% Overall efficiency
- 66% Creosote reduction

For further information on the Lakewood Stove that is best for you, contact:

Lakewood Stoves

EFFICIENCY & QUALITY

UNLOCKS A NEW CONCEPT for woodburning Stoves....

P.O. BOX 409
BOBCAYGEON, ONTARIO K0M 1A0

The fire that burns twice

Unique Kent design

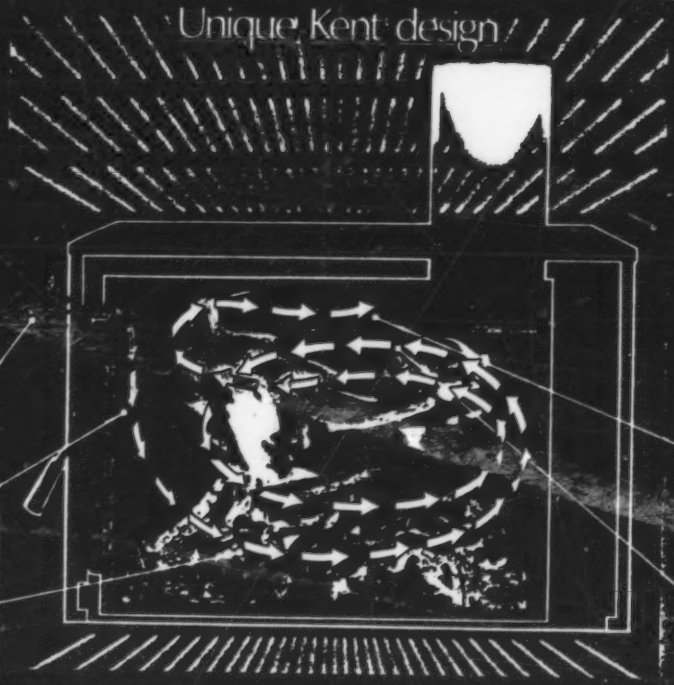
Like any fuel, wood needs oxygen and heat to make it burn. As it burns, moisture is driven out and the wood begins to release volatile gases as it turns to charcoal. The charcoal gradually burns away, leaving just a fine white ash.

The Kent Wood Burning Process

1 *Combustion air enters above the door.*

2 *The air passes over the door and is preheated.*

3 *Air passes through the firebed and around the wood.*



Kent's twice-burning action is based on an exclusive second burning chamber where carbon-rich gases that normally escape up the chimney are burned completely. So the Kent Wood Burning Process offers up to four times the heating efficiency of an open fire.

5 *Products of combustion pass under, then through the baffled chamber, then up the flue to the atmosphere.*

4 *Products of combustion and excess air are mixed and pass through the fire again.*

Fingertip Control The slide control regulates the fire from blazing to steady glow.

Failsafe Lock On the Tile Fire and Log Fire the flue damper control locks the door for added safety.

Ceramic Glass The ceramic glass is both heat and impact resistant, and rarely needs cleaning.

Less Cleaning The ash in a Kent Wood Stove needs removing only once every four weeks or so.

Easy-Clean Outer Surface The Tile Fire and Log Fire require only occasional cleaning because of the easy-clean features of vitreous enamel. Dirt and spills wipe right off.

Safety Handle The handle is heat resistant for safety.

Kent products have been thoroughly tested and approved by independent test laboratories in New Zealand and the United States. They carry Underwriters Laboratories listings in the United States and Canada, and New Zealand Clean Air Council approval. They also carry the coveted New Zealand Designmark.

© 1983 Kent Heating Limited

Installation:

The Free-Standing Stove [illegible] Unlike many single walled free-standers, the rear of the stove may be placed as close as 14" to the wall in a conventional home. (Clearances can be further reduced by using heat resistant screens – see your Kent Dealer for details.) The stove must be fitted on a non-combustible hearth extending at least 18" from the front of the unit. Each unit comes complete with detailed standard installation and operating instructions.

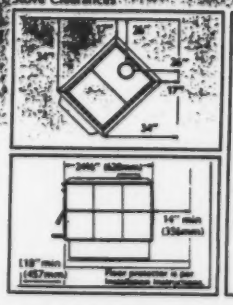
The Free-Standing Stove [illegible] ...neatly interchangeable ... highly ... feature. Choose from one of our tile designs or select ... No gluing, no grouting, simply lift the top and slide tiles in or out of the special grid frame. The Tile Fire incorporates many attractive safety features too. The back and bottom of the stove are double walled to stay cool. An airspace separates the tile sides from the main firebox so the stove may be installed close to a wall. Just set your coffee pot or mug on the attractive grille to keep things warm. Or remove the grille and cook directly on the inner surface.

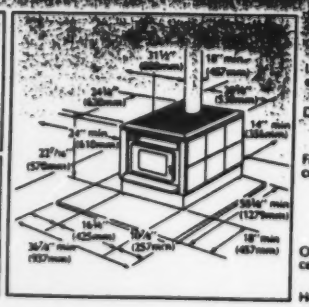
Construction:

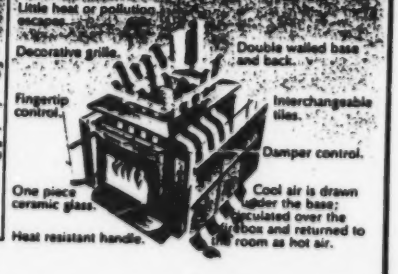
[illegible] ...supported on ... which stand ... easily. The perforated grille lifts off ...

The heating capacity of The Tile Fire is 50,000 B.t.u.'s.

Stove Clearances






Little heat or pollution escapes.
Decorative grille.
Fingertip control.
One piece ceramic glass.
Heat resistant handle.
Double walled base and back.
Interchangeable tiles.
Damper control.
Cool air is drawn under the base; circulated over the firebox and returned to the room as hot air.

The Log Fire

The Sherwood

For Your Existing Fireplace

Functional Free-Stander

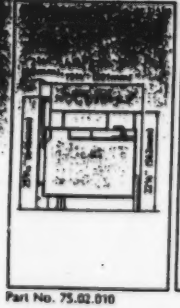
Installation:

Installation:

Construction:

Construction:

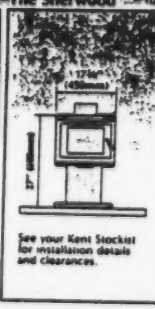
The Log Fire



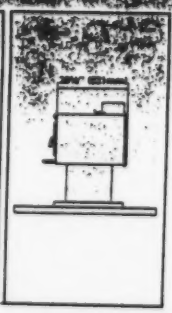
Distributed in Canada by:
PROCAM LIMITED
Westmeath Industrial Park
Highway 17 East
Pembroke, Ont. K8A 6W3
Telex 053-34536 — Tel: (613) 735-1034

KENT
59 Tidal Road, Mangere, Auckland, New Zealand

The Sherwood



See your Kent Stockist for installation details and clearances.



Part No. 75.02.010

SAVE THESE INSTRUCTIONS AND READ CAREFULLY

Installation and Operating Instructions

Model VG3083

Use this appliance only in accordance with this manual. Failure to do so may result in a fire hazard.

VOLCANIC GLOW STOVES LTD.

R.R.2, Elmira, Ontario
CANADA
N3B 2Z2

Model VG3083

WARNOCK HERSEY
LISTED

The New Volcanic Glow Stove

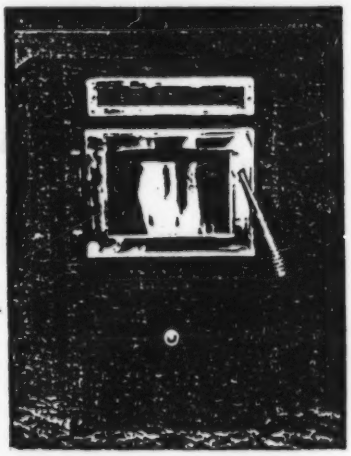
At last — a modern wood stove that combines all the advantages of wood with the convenience of oil or gas !

That s right — The Volcanic Glow Stove is specially designed to burn the newest innovation in alternative fuels — wood pellets (see below) Just load the pellets in the large hopper and they are automatically fed to the flame by the unique Volcanic Glow auger system. Pellet feed is thermostatically controlled for optimum comfort Air is fed to the bright, steady "volcanic glow" flame by the combustion fan to provide maximum combustion efficiency

Air is gently forced into your room by the circulating fan

Heavy-duty nickel plated door with 8" X 11" glass window.

High-temperature Pyro Ceram 5 mm non shatter safety glass



Large pellet hopper holds enough fuel for more than 24 hours of heating.

Pellets are automatically fed by the thermostatically controlled auger system.

Solid, heavy-duty 3/16" steel construction.

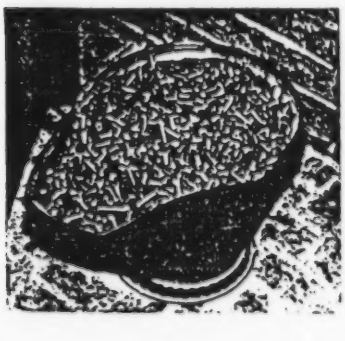
Ash removal is necessary only once a week.

Specifications

Width	30"
Height	36"
Depth (including hopper)	38"
Weight	350 lbs
Flue Size	6"
Heating Capacity	2 000 sq ft
Heat Output (app)	60,000 BTU/hr
Clearances - Sides	20"
Rear	3"
Combustion Blower	1600 rpm
Circulating Blower	3000 rpm variable speed

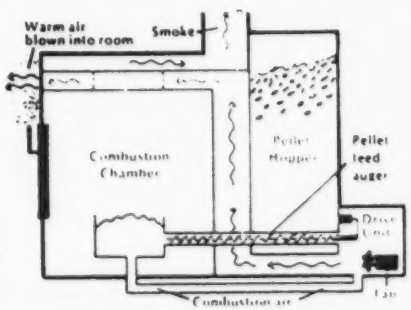
COSP No WWV051
Tested to UL 1482
ULC S627
CSA B366 2M

Wood Fuel Pellets — a fuel of the future !



Wood fuel pellets are made from treebark and sawdust, and because they are in dehydrated form they are all wood

Unlike regular fire wood pellets have only 10% water content This means they burn cleanly and efficiently creating very little smoke virtually no creosote and leaving only a small amount of ash



Pellets are fed by auger to flame Warm air is gently circulated into room by fan

DEALER

Volcanic Glow Stoves Ltd.
R.R. 2 Elmira, Ontario
(519) 669-1733

Canadian and U S A patents pending

Tehokasta tekniikkaa pannuhuoneeseen

TP 2000 poltin

- Laita TP 2000 poltin kattilaasi — kotimaisen polttoaineen helpoin käyttötapa.
- Ei savuhaittoja.
- Polttoaineena hienohake, palaturvemurske tai pelletti.
- Poltin on automaattinen ja varmatoiminen.
- Erittäin korkea hyötysuhde takaa vähäisen polttoaineen kulutuksen.

Kolme kokoa:
- 180/10 kW
- 360/17 kW
- 500/25 kW

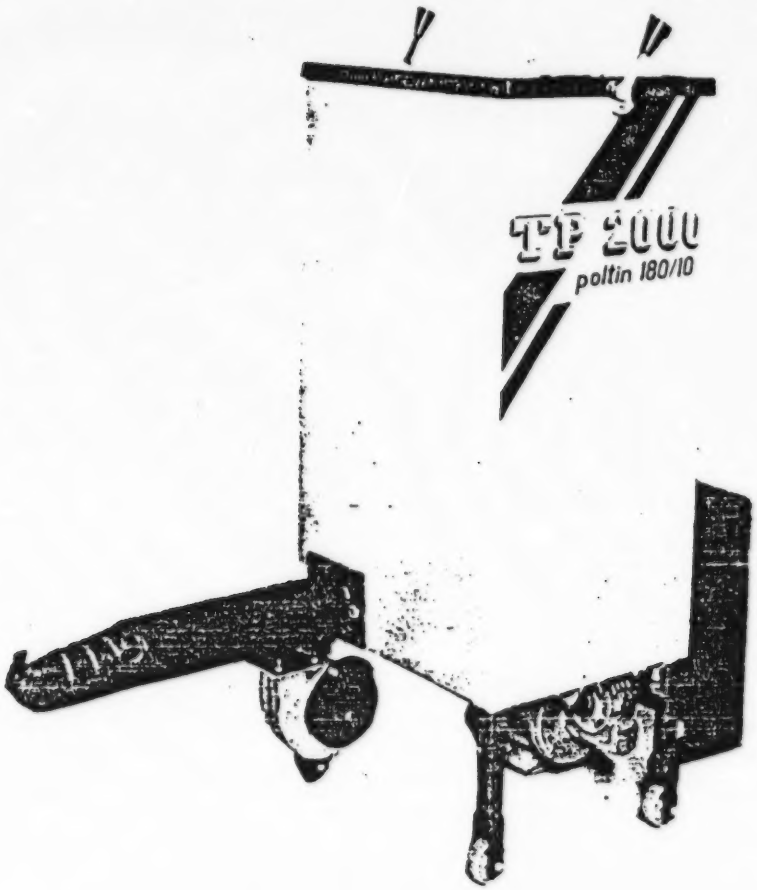
- Poltin voidaan asentaa useimpiin eri kattilatyyppeihin.

MYYJÄ:

Timi
Topi Pämppi
27100 EURAJOKI
☎ 938-80 222

TP 2000 STOKER

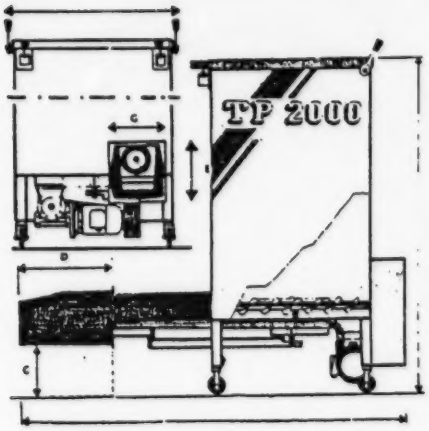
FOR
BIOFUEL COMBUSTION



FOR WOODCHIPS AND VARIOUS FUEL PELLETS.
Capacities: 30 000, 60 000, 90 000 & 150 000 BTU

TP 2000 STOKER

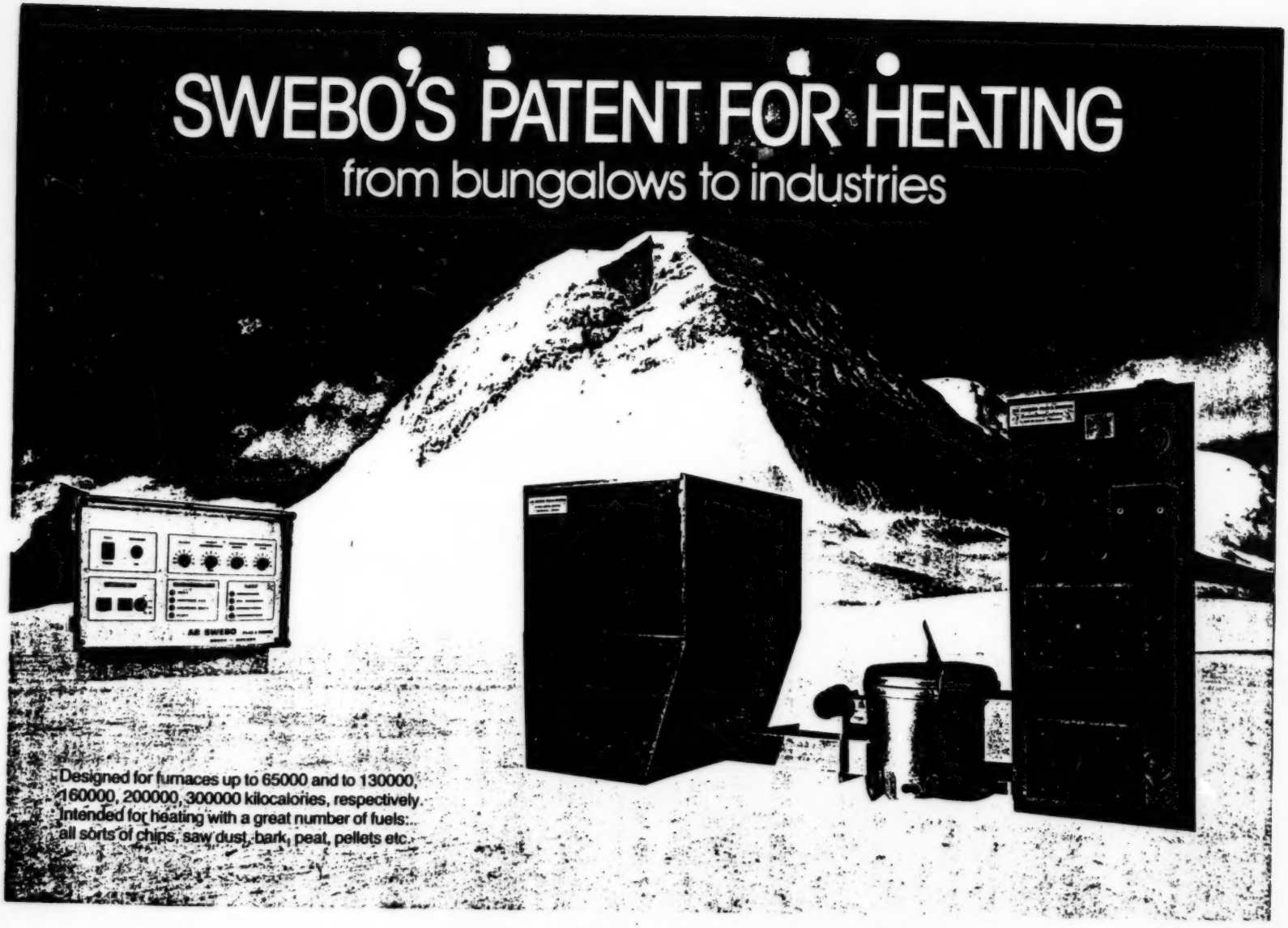
Measurements
(in inches)

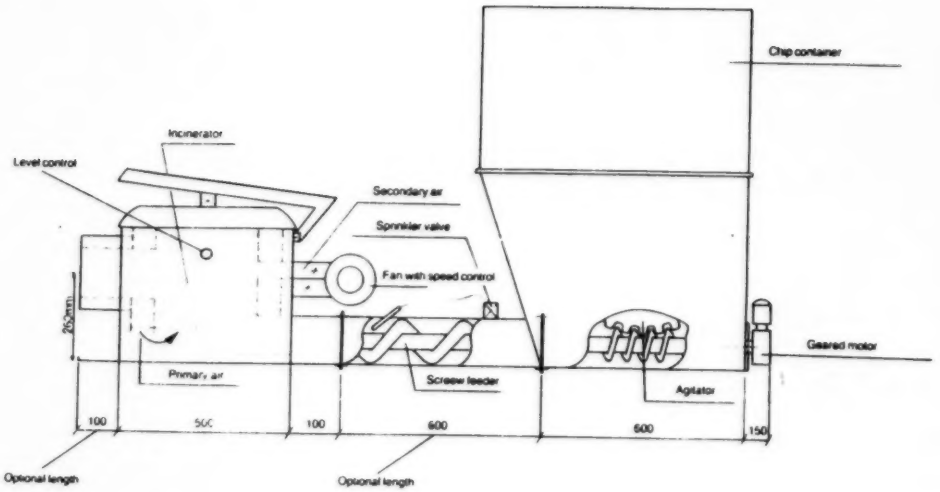


	Capacities x 1000 BTU			
	30	60	90	150
A	43	57	61	79
B Min	45	51	51	59
B Max	49	51	51	--
C Min	13	12	12	20
C Max	17	13	13	20
D	12	14	15	16
E	Ø5	Ø7	10	12
G	Ø5	Ø7	10	12
F	20	24	28	40
Volume of reservoir (gal)	47 g	94 g	130 g	260 g
Weight lbs	240	280	400	660

The function of the stoker is regulated by the control panel which is connected to the boiler thermostat of a hot-water boiler or a room thermostat in a hot-air furnace system. The stoker burner operates only when heat is required. The fuel is kept smoldering by the control unit when heat is not required.

The combustion bowl is cast iron. A fixed grate is used in the two smallest units, otherwise a mechanical grate is employed.


SWEBO'S PATENT FOR HEATING
from bungalows to industries
Designed for furnaces up to 65000 and to 130000, 160000, 200000, 300000 kilocalories, respectively.
Intended for heating with a great number of fuels:
all sorts of chips, saw dust, bark, peat, pellets etc.



Funktioning

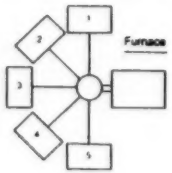
This chip-burning installation is built for reliability in heating. The agitator feeds successfully all sorts of fuel: saw dust, chips (coarse, fine or green), bark, peat, pellets etc. All fuels can be mixed. The chip-burning plant is equipped with an electronic control system which guarantees a perfect regulation of the combustion.

Description

The Swebo system for chip burning consists of a container provided with an agitator. The agitator is connected to a screw feeder which conveys the fuel to the incinerator. The fan provides for secondary and primary air supply.

More alternative connections

The incinerator can easily be connected to an already existing furnace. The placing of the container provides a variety of alternatives according to available space.



Specification

The complete construction for chip burning: 65-08.

Length	2100 mm or as required
Width	1060 mm or as required
Height	1200 mm
Shaft shoulder	230 × 230 mm
Chip container	800 alternatively 1200 litres

Container of 4,5 cu.m. can also be connected to a large silo.

The construction can be built according to requirement.

Operation economy

Make your own calculation:
1 cu.m. of piled wood gives approx. 1,7 cu.m. of chips. 12 cu.m. of chips give the same heating value as 1 cu.m. of oil.

Oil

I buy _____ cu.m. of oil p.a.

I pay _____ pounds per cu.m.

Oil costs _____ pounds

Chips

To let the chips have the same heating value as the oil
I need _____ cu.m. of chips.
(12 × the number of cu.m. of oil)

To get the same heating costs by chip burning as by oil burning I would only pay _____ pounds per cu.m. of chips.

Dealer: _____

Manufacturer:

AB SWEBO FLIS & ENERGI
0921-152 54, 524 90 961 38 BODEN
Mobiltel. 010-580059 SWEDEN

TRYCKARNA, BODEN